Mortality in Patients Hospitalized for Asthma Exacerbations in the United States

Vidya Krishnan, Gregory B. Diette, Cynthia S. Rand, Andrew L. Bilderback, Barry Merriman, Nadia N. Hansel, and Jerry A. Krishnan*

Division of Pulmonary and Critical Care Medicine, Department of Medicine, Johns Hopkins School of Medicine; Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland

***Rationale*: Hospitalizations for asthma exacerbations are common in the United States, but there are no national estimates of outcomes in this population. It is also not known if race disparities in asthma deaths exist among hospitalized patients.**

***Objectives*: To estimate outcomes of patients hospitalized for asthma in the United States and to determine if the risk of death in this population is higher among black patients compared with white patients.**

***Methods*: We used the Nationwide Inpatient Sample for 2000. Admissions for asthma exacerbations among patients > 5 yr of age were included. Mortality was the primary outcome; secondary outcomes were length of stay and total hospital charges.**

***Measurements and Main Results*: In-hospital asthma mortality was 0.5% (99% confidence interval [CI], 0.4–0.6), with mean hospital stay of 2.7 d (99% CI, 2.6–2.8 d) and $9,078 (99% CI, $8,300–9,855) in hospital charges. Deaths in this population accounted for about one-third of all asthma deaths reported in the United States. Black patients hospitalized for asthma exacerbations were less likely to die when compared with white patients (0.3 vs. 0.6%; $p < 0.001$). However, in multivariable analyses, there were no significant race differences in hospital deaths.**

***Conclusions*: Mortality among patients hospitalized for asthma exacerbations accounts for one-third of all deaths from asthma. The higher overall risk of death from asthma in black patients compared with white patients in the United States is not explained by race differences in hospital deaths and therefore is attributable to factors preceding hospitalization.**

Keywords: costs; epidemiology; length of stay; mortality; race

Asthma is a chronic disorder characterized by episodic respiratory symptoms (e.g., dyspnea, cough, and wheeze) and hyperreactivity to environmental exposures. There are an estimated 300 million patients with asthma worldwide (1), including 20 million in the United States (2). Each year in the United States, about 11 million patients have an acute deterioration of respiratory symptoms (i.e., asthma exacerbation) after a respiratory viral infection or exposure to environmental allergens or irritants (3). Although most asthma exacerbations are managed in the outpatient setting, more severe exacerbations may require hospitalization and are responsible for a substantial proportion of health care expenditures for asthma. In the United States, severe asthma exacerbations lead to over 400,000 hospitalizations each year, and these hospitalizations constitute about one-third of the total $11.5 billion in annual asthma-related health care expenditures (4).

Although the immense health and financial burden of severe asthma exacerbations is widely recognized, there are no national estimates of outcomes among patients hospitalized for asthma exacerbations in the United States. These data would provide a benchmark for cross-sectional and longitudinal comparisons of outcomes among hospitals, health plans, and geographic regions. Also, although rates of hospitalization and death from asthma are 2.5–5 times higher among blacks compared with whites (5, 6), it is not known if death rates from asthma among hospitalized patients differ by race.

To address these gaps in knowledge, we conducted a study to obtain national estimates of mortality, length of hospital stay, and total hospital charges among patients hospitalized for asthma exacerbations in the United States and to determine if mortality in this population was greater in black patients than in white patients. Preliminary results of this study were presented in abstract form (7).

METHODS

We used the Agency for Healthcare Research and Quality–sponsored Nationwide Inpatient Sample (NIS) because it is the largest all-payer source of data on hospitalized patients in the United States (8). The NIS contains data on all admissions from a 20% stratified probability sample of all acute care nongovernmental hospital admissions in the United States and was designed to provide national estimates of outcomes in this population (9–12). The NIS 2000 data coincide with the release of the Healthy People 2010 initiative, a roadmap for United States' health improvement efforts from 2000 to 2010 (13), and therefore provide the unique opportunity to establish a baseline against which changes in outcomes of hospitalized patients during this national initiative can be evaluated.

Admission records were included in this study if the primary discharge diagnosis was (*1*) asthma (International Classification of Diseases, Ninth Revision, 493.xx) (14) or (*2*) acute respiratory failure, distress, or arrest (518.81, 518.82, 799.1), with a secondary diagnosis of asthma. Children younger than 5 yr were excluded, as has been done previously (6), because of the difficulty in establishing asthma in this population. Admission records without data on hospital mortality were also excluded.

The primary outcome was hospital mortality. Secondary outcomes were length of hospital stay (number of days from hospital admission to discharge) and total hospital charges. Intubation or mechanical ventilation (i.e., procedure codes 96.04, 93.90, 96.70, 96.71, or 96.72) during hospitalization, a marker of life-threatening asthma, was also ascertained.

Race was the primary patient characteristic of interest. The NIS also provides data on patients' sex, age, median household income based on zip code (15), and health insurance. Admission characteristics (admission source [clinic/physician, emergency department, and transfers], weekend admission [yes/no], discharge quarter [October–December, January–March, April–June, and July–September]) and hospital characteristics (geographic region, teaching status, and rural/urban location) were also available for analysis. Based on discharge diagnoses,

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*Present affiliation: Section of Pulmonary/Critical Care Medicine, Department of Medicine, University of Chicago, Chicago, Illinois.

Correspondence and requests for reprints should be addressed to Jerry A. Krishnan, M.D., Ph.D., Section of Pulmonary/Critical Care Medicine, Department of Medicine, University of Chicago, Chicago, IL 60637. E-mail: jerry.krishnan@gmail.com

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we calculated the Deyo-adapted Charlson Index (16–18) for each admission. The Deyo-adapted Charlson Index is a validated measure of comorbidity for use in administrative data analyses: 1 (asthma only), 2 (one other condition), 3 (two other conditions), and ⩾ 4 (three or more other conditions).

Using NIS hospital discharge weights (19), we calculated national estimates of hospital mortality, length of stay, and total charges (*see* the online supplement). In bivariate analyses, we used χ^2 tests and linear regression as appropriate. To determine if race differences in mortality could be explained by other patient and admission characteristics, we developed simple and multivariable Poisson regression models that accounted for possible within-hospital correlation of outcomes (20, 21) and evaluated the appropriateness of these models using goodness-of-fit tests. We assessed the sensitivity of our results to missing data using three approaches. In this article, we present the results of our analyses using data restricted to admissions from states that reported race (79.8% of all admission records for asthma exacerbations). Details and results of the other two approaches, which produced similar results, are available in the online supplement. Because it is possible that older patients with chronic obstructive pulmonary disease may have been misclassified as having asthma, we repeated the analyses within strata defined by age (5–34 yr and ⩾ 35 yr).

A two-tailed p value < 0.01 was used to detect statistically significant differences because of the large number of records and multiple comparisons. Analyses were performed using STATA version 8.2 (Stata Corp., College Station, TX).

RESULTS

National Estimates of Hospital Mortality, Charges, and Length of Stay

Among 7,450,992 hospital admissions in the NIS, 81,900 records were for asthma exacerbations. Of these, 16,508 admissions occurred in patients younger than 5 yr, and 11 records had missing data on hospital mortality and were therefore excluded. Therefore, 65,381 hospital admissions met our study eligibility criteria (Table 1). Patients hospitalized for asthma exacerbations were most likely to be white, female, and admitted through the emergency department. The overall hospital mortality for asthma exacerbations was 0.5% (99% confidence interval [CI], 0.4–0.6; Table 2). The overall mean hospital length of stay was 2.7 d (99% CI, 2.6–2.8 d), and mean hospital charge was $9,078 (99% CI, $8,300–9,855). Patients 5–34 yr of age accounted for a minority of asthma deaths (21.4%); most asthma deaths (78.6%) occurred in patients 35 yr or older.

Using the NIS hospital discharge weights, our analyses indicate that a total of 1,499 hospital deaths were due to asthma in the United States for 2000. We estimate that asthma exacerbations accounted for 1.1 million hospital days and $2.9 billion in charges. Fewer than 5% of admissions involved intubation/mechanical ventilation (Table 2). These admissions were associated with a higher risk of death, longer length of hospital stay, and higher hospital charges compared with admissions without intubation/mechanical ventilation (Table 2).

Comparison of Outcomes by Hospital Characteristics

Hospital mortality was similar across geographic regions, by teaching status, and in rural/urban hospitals. By contrast, there were significant differences in the proportion of patients who underwent intubation/mechanical ventilation, with rates highest in the West and lowest in the South (Table 3). Teaching hospitals and urban hospitals also had significantly higher rates of intubation/mechanical ventilation. Hospital stays in the Northeast were significantly longer than in other regions; however, the magnitude of differences in length of stay across different hospital regions was relatively small (up to 0.7 d).

TABLE 1. PATIENT AND ADMISSION CHARACTERISTICS FOR STUDY POPULATION (n = 65,381)

Patient Characteristics	n (%)
Race	
White	26,521 (40.6)
Black	13,681 (20.9)
Hispanic	6,645 (10.2)
Asian/Pacific Islander	968 (1.5)
Other	1,895 (2.9)
Missing	15,671 (24.0)
Age, yr	
5–14	12,928 (19.8)
15–34	12,014 (18.4)
35–54	20,752 (31.7)
55–74	13,106 (20.1)
⩾ 75	6,581 (10.1)
Missing	0 (0.0)
Sex	
Female	43,270 (66.2)
Male	22,101 (33.8)
Missing	10 (0.02)
Median income by zip code, $	
1–24,999	9,480 (14.5)
25,000–34,999	21,274 (32.5)
35,000–44,999	15,454 (23.6)
⩾ 45,000	18,089 (27.7)
Missing	1,084 (1.7)
Insurance status	
Medicaid	16,144 (24.7)
Private	25,826 (39.5)
Other	23,047 (35.3)
Medicare	15,619 (23.9)
No charge	307 (0.5)
Self-pay	4,924 (7.5)
Other	2,197 (3.4)
Missing	364 (0.6)
Deyo-adapted Charlson Index	
1	50,761 (77.6)
2	11,334 (17.3)
3	2,694 (4.1)
⩾ 4	592 (0.9)
Missing	0 (0.0)
Admission characteristics	
Admission source	
Clinic/physician	17,515 (26.8)
Emergency department	44,579 (68.2)
Transfer	1,495 (2.3)
Other hospital	1,122 (1.7)
Other facility	354 (0.5)
Court/law enforcement	19 (0.03)
Missing	1,792 (2.7)
Admit on weekend	
No	49,645 (75.9)
Yes	15,736 (24.1)
Missing	0 (0.0)
Discharge quarter	
Fall (October–December)	18,840 (28.8)
Winter (January–March)	19,083 (29.2)
Spring (April–June)	13,691 (21.4)
Summer (July–September)	13,467 (20.6)
Missing	0 (0.0)

Categories may not sum to 100% due to rounding.

Comparison of Hospital Mortality by Race

Bivariate analyses. Overall, black and Hispanic patients had a significantly lower risk of hospital mortality compared with white patients (Figure 1, Table 4). Patients with missing race data were less likely to die than white patients, but differences between groups were not significant. Black patients were significantly more likely to undergo intubation/mechanical ventilation compared with white patients (4.8 vs. 4.0%; p = 0.001). In this

TABLE 2. OUTCOMES STRATIFIED BY USE OF INTUBATION/MECHANICAL VENTILATION

Outcome	All (*n = 65,381*)	Intubation/Mechanical Ventilation	
		No (*n = 62,611; 95.8%*)	Yes (*n = 2,770; 4.2%*)
Hospital mortality, % (99% CI)	0.5 (0.4–0.6)	0.2 (0.1–0.2)	6.9 (5.7–8.3)†
Length of stay, mean days (SE)	2.7 (0.03)	2.6 (0.03)	5.4 (1.0)†
Alive	2.7 (0.03)	2.6 (0.03)	5.4 (1.0)†
Dead	5.4 (0.4)*	4.8 (0.6)*	5.9 (1.1)
Total charges, mean $ (SE)	9,078 (301)	7,912 (262)	35,939 (1,461)
Alive	8,918 (296)	7,870 (260)	34,764 (1,481)†
Dead	43,340 (3,465)*	29,791 (5,560)*	51,917 (4,315)*†

* $p < 0.001$ for comparison to "alive" group.
† $p < 0.001$ for comparisons to "yes" intubation/mechanical ventilation status.

subgroup, black patients had a lower, but not significantly different, risk of hospital death compared with white patients (relative risk, 0.62; 99% CI, 0.38–1.02). Differences in hospital mortality between white patients and other races in the subgroup of patients who underwent intubation/mechanical ventilation were also not significant (data not shown).

In analyses restricted to patients 5–34 yr of age, black patients had a higher, but not significantly different, risk of death compared with white patients (0.11 vs. 0.09%; $p = 0.78$). In patients 35 yr of age or older, mortality was significantly lower in black patients compared with white patients (0.5 vs. 0.9%; $p = 0.0006$).

Multivariable analyses. After simultaneously accounting for other patient and admission characteristics, the risk of death among black patients was overall not significantly different compared with white patients (Table 4). Older age, male sex, admissions from sources other than clinic/physician referrals, and more comorbid conditions were independently associated with increased hospital mortality (Table 4). The Poisson multivariable model demonstrated a good fit of the data ($p = 0.99$).

When the population was stratified by age (5–34 yr, ⩾ 35 yr), black patients had a higher (but not significantly different) mortality compared with white patients in the younger age group and lower (but not significantly different) mortality compared with white patients in the older age group (Table 5). The 99% CIs for the multivariable analyses stratified by age group, particularly in patients 5–34 yr of age, were wide, indicating inadequate power for these subgroup analyses.

DISCUSSION

Using the largest available nationally representative dataset of hospitalizations in the United States, we found that the overall risk of death from asthma exacerbations in patients 5 yr or older is 0.5%, and we estimated there were 1,499 hospital deaths in the United States in 2000 due to asthma. Although asthma mortality is several-fold higher in blacks compared whites in the overall U.S. population (5, 6), black patients hospitalized for asthma exacerbations were not significantly more likely to die than their white counterparts. Even after accounting for other patient and admission characteristics and performing age-stratified analyses, we failed to detect a significantly higher rate of death among black patients hospitalized for asthma exacerbations. These findings suggest that the race disparity in asthma mortality in the United States is attributable to factors that precede hospital admission.

Previous studies that provided estimates of hospital mortality from asthma exacerbations were limited to individual hospitals or intensive care units or were from regions outside the United States. These studies supported a wide range of hospital mortality estimates (0.4–12%) (22–24). Our findings, based on nationally representative data, indicate that the overall risk of death in patients hospitalized for asthma exacerbations in the United States is 0.5%.

Intubation/mechanical ventilation was uncommon (about 4% of all asthma admissions) and was associated with significantly higher risk of death. Intubation/mechanical ventilation was significantly more common in the West (70% higher than in other regions), teaching hospitals (40% more likely than in nonteaching hospitals), and urban hospitals (over 200% more likely than in rural hospitals). The NIS does not contain patient-level data about the severity of asthma exacerbations, so we were unable to determine if higher rates of intubation/mechanical ventilation reflect differences in patient characteristics or physician practices.

Our study indicates that 1,499 deaths (33% of all 4,487 deaths from asthma in the United States in 2000 reported by the Centers

TABLE 3. OUTCOMES STRATIFIED BY HOSPITAL CHARACTERISTICS

Outcome	Region				Teaching Status†		Location†	
	Northeast (*n = 15,642*)	Midwest (*n = 14,266*)	South (*n = 24,113*)	West (*n = 11,360*)	Nonteaching (*n = 36,797*)	Teaching (*n = 28,517*)	Rural (*n = 10,897*)	Urban (*n = 54,417*)
Hospital mortality, %	0.6	0.4	0.4	0.6	0.5	0.4	0.4	0.5
Intubation/MV, %	4.5	4.5	3.3	5.6*	3.6	5.0*	2.0	4.7*
Intubation/MV among patients who died, %	62.2	69.0	62.2	56.3	52.3	77.2*	46.5	64.9
LOS, mean days (SE)	3.1 (0.06)	2.4 (0.06)	2.9 (0.04)	2.5 (0.06)*	2.8 (0.03)	2.6 (0.06)	2.7 (0.06)	2.7 (0.04)
Total charges, $ (SE)	10,000 (665)	7,684 (297)	7,554 (335)	13,165 (1,320)*	8,556 (434)	9,762 (465)	5,610 (168)	9,796 (376)*

Definition of abbreviations: LOS = length of stay; MV = mechanical ventilation.
* $p < 0.001$ for differences between groups of hospitals based on specified characteristics.
† Sixty-seven records missing data on teaching status and location.

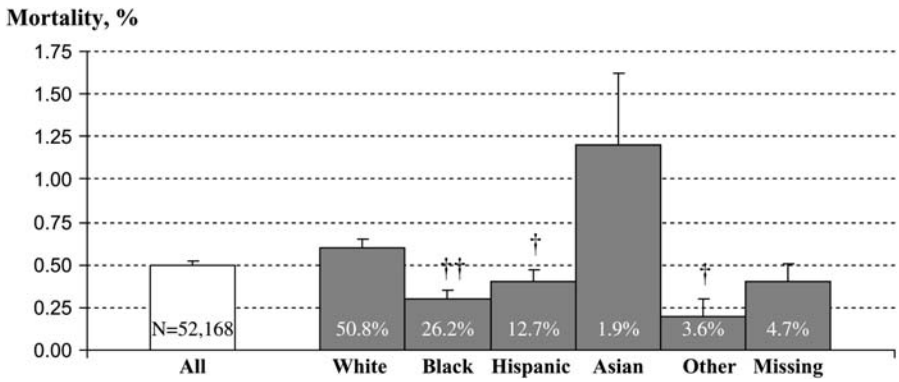

Figure 1. Hospital mortality by race (n = 52,168). Excludes states without race data (Georgia, Illinois, Kentucky, Maine, Oregon, Washington, West Virginia). Numbers within *bars* indicate percentage of all 52,168 admissions with specified race. *Error bars* represent standard errors. †p < 0.01, ††p < 0.001 compared with white patients.

TABLE 4. PREDICTORS OF HOSPITAL MORTALITY*

	Bivariate Analyses		
Patient Characteristics (*n = 52,168*)	Hospital Deaths (%)	Unadjusted RR (*99% CI*)	Multivariable Analyses, Adjusted RR (*99% CI*)
Race			
White	0.6	1.00	1.00
Black	0.3	0.46 (0.30–0.72)†	0.73 (0.46–1.16)
Hispanic	0.4	0.59 (0.35–0.99)†	0.81 (0.47–1.40)
Asian/Pacific Islander	1.2	1.81 (0.68–4.79)	1.33 (0.50–3.54)
Other	0.2	0.34 (0.11–1.03)	0.44 (0.14–1.40)
Missing (4.7%)	0.4	0.57 (0.25–1.29)	0.65 (0.27–1.53)
Age, yr			
5–14	0.02	1.00	1.00
15–34	0.2	9.15 (1.33–62.84)†	8.84 (1.27–61.66)†
35–54	0.3	15.60 (2.46–99.08)†	13.75 (2.11–89.56)†
55–74	0.8	38.80 (6.39–235.60)†	26.76 (4.19–170.87)†
⩾ 75	1.9	95.45 (15.43–590.60)†	55.53 (8.15–378.30)†
Missing (0.0%)	N/A	—	—
Sex			
Female	0.5	1.00	1.00
Male	0.5	1.01 (0.73–1.39)	1.39 (1.01–1.91)†
Missing (0.02%)	0.0	‡	‡
Median income by zip code, $			
1–24,999	0.3	1.00	1.00
25,000–34,999	0.5	1.52 (0.83–2.77)	1.30 (0.72–2.35)
35,000–44,999	0.6	1.70 (0.93–3.12)	1.35 (0.75–2.43)
⩾ 45,000	0.6	1.69 (0.96–2.99)	1.21 (0.67–2.18)
Missing (1.7%)	0.5	1.43 (0.37–5.62)	1.16 (0.30–4.38)
Insurance status			
Medicaid	0.3	1.00	1.00
Private	0.3	1.15 (0.64–2.09)	0.96 (0.52–1.76)
Other	0.9	3.56 (2.13–5.94) †	0.99 (0.56–1.77)
Missing (0.6%)	0.7	2.72 (0.36–20.24)	1.17 (0.19–7.15)
Deyo-adapted Charlson Index			
1	0.3	1.00	1.00
2	0.8	2.80 (1.98–3.97)†	1.55 (1.07–2.26)†
3	2.2	7.65 (4.84–12.09)†	3.32 (2.02–5.45)†
⩾ 4	4.1	13.98 (7.79–25.10)†	5.64 (3.03–10.48)†
Missing (0.0%)	N/A	—	—
Admission characteristics			
Admission source			
Clinic/physician	0.3	1.00	1.00
Emergency department	0.5	1.78 (1.13–2.80)†	1.73 (1.09–2.76)†
Transfer	1.2	3.82 (1.62–8.88)†	3.44 (1.50–7.92)†
Missing (3.4%)	0.6	2.07 (0.81–5.30)	2.01 (0.76–5.33)
Admit on weekend			
No	0.5	1.00	1.00
Yes	0.6	1.25 (0.88–1.78)	1.18 (0.82–1.70)
Missing (0.0%)	N/A	—	—
Discharge quarter			
Fall (October–December)	0.4	1.00	1.00
Winter (January–March)	0.6	1.72 (1.09–2.73)†	1.37 (0.86–2.17)
Spring (April–June)	0.5	1.51 (0.89–2.55)	1.35 (0.80–2.28)
Summer (July–September)	0.5	1.55 (0.91–2.67)	1.56 (0.91–2.69)
Missing (0.0%)	N/A	—	—

Definition of abbreviations: CI = confidence interval; N/A = not applicable; RR = relative risk.

* Excludes states that did not report race data (Georgia, Illinois, Kentucky, Maine, Oregon, Washington, West Virginia).

† p < 0.01.

‡ Numbers too small to produce reliable estimates.

TABLE 5. AGE-STRATIFIED IN-HOSPITAL ASTHMA MORTALITY*

	Age 5–34 yr (*n = 19,908*)		Age ⩾ 35 yr (*n = 32,260*)	
Race (*n = 52,168*)	Bivariate Analyses, Unadjusted RR (*99% CI*)	Multivariable Analyses,‡ Adjusted RR (*99% CI*)	Bivariate Analyses, Unadjusted RR (*99% CI*)	Multivariable Analyses,‡ Adjusted RR (*99% CI*)
White	1.00	1.00	1.00	1.00
Black	1.16 (0.28–4.77)	1.66 (0.35–7.96)	0.52 (0.32–0.84)§	0.66 (0.41–1.08)
Hispanic	0.37 (0.02–6.00)	0.59 (0.04–8.99)	0.73 (0.45–1.20)	0.83 (0.48–1.41)
Asian/Pacific Islander	4.82 (0.31–75.08)	6.29 (0.31–128.76)	1.52 (0.60–3.83)	1.18 (0.47–2.93)
Other	—†	—†	0.44 (0.15–1.33)	0.46 (0.14–1.46)
Missing	3.87 (0.71–20.94)	4.11 (0.74–22.79)	0.41 (0.16–1.07)	0.45 (0.17–1.17)

* Excludes states that did not report race data (Georgia, Illinois, Kentucky, Maine, Oregon, Washington, West Virginia).

† Numbers too small to produce reliable estimates.

‡ Adjusted for age, sex, median income by zip code, insurance status, admission source, discharge quarter, and Deyo-adapted Charlson comorbidity index in multivariable Poisson regression model.

§ $p < 0.001$.

for Disease Control and Prevention [CDC] [5]) occurred in patients hospitalized for asthma exacerbations. Even if children younger than 5 yr were included in our study, our estimate would only slightly increase to 1,508 hospital deaths (34% of 4,487 deaths), suggesting that the majority of all asthma deaths occur before hospitalization. This observation is consistent with a published review of death certificates in the United States from 1979 to 1984 (25) and highlights the continued need for public health efforts to reduce out-of-hospital deaths from asthma exacerbations. Furthermore, our analyses of data from 2000 failed to detect a significantly higher risk of in-hospital deaths among blacks despite a 2.5- to 5-fold higher risk of death from asthma exacerbations in the overall U.S. population. Taken together, these observations suggest a gap in out-of-hospital asthma deaths by race (i.e., black patients were more likely to die of asthma exacerbations out-of-hospital than white patients). Potential explanations include difficulties in accessing adequate healthcare (26), poor preventative management practices (e.g., nonadherence) (27, 28), and delays in seeking medical attention (29, 30), which are known to be more common among blacks compared with whites in the United States. These considerations suggest that the subset of patients hospitalized for asthma exacerbations may not be representative of all patients with severe and potentially life-threatening exacerbations.

Our study has two principal strengths. First, the data were derived from a nationally representative sample of hospital admissions. Therefore, our estimates of outcomes are not limited to specific subpopulations of hospitalized patients with severe asthma exacerbations. Second, we examined whether race disparities in asthma deaths extended into the hospitalized setting. Results suggest that the higher risk of asthma death among blacks compared with whites in the overall U.S. population is attributable to an excess risk of deaths before hospitalization.

This study has methodologic limitations that should be considered when interpreting our results. Our analyses are restricted to the data available in the NIS dataset, so further exploration of other factors related to socioeconomic status, such as access to care and quality of care, was not possible. Also, the validity of our results depends on the accuracy of data (e.g., discharge diagnoses, procedure codes, and race). There are no unique patient identifiers in the NIS, so studies to evaluate the validity of these data (e.g., by examining the United States' vital records) are not possible. However, when analyses were restricted to the subgroup of patients 5–34 yr of age (to minimize the risk of including patients with chronic obstructive pulmonary disease), we were still unable to detect a significantly higher risk of death among blacks compared with whites. Lack of patient identifiers also precluded analyses examining the effect of readmissions on our findings. We found 81,900 records for asthma admissions (all ages) in 2000, which represent about 401,000 hospital admissions for asthma, based on the NIS hospital discharge weights. Thus, our analyses are based on about 86% of the CDC estimate of 465,000 admissions in 2000, which suggests that we have missed a small proportion of hospitalizations for asthma exacerbations in the United States, particularly admissions to government hospitals (e.g., Veterans' Health Administration hospitals), which are not included in the NIS 2000 dataset.

The results of this study have important implications for researchers and policy makers. We present a comprehensive estimate of mortality, length of stay, and charges for patients hospitalized for asthma exacerbations in the United States and examined race differences in mortality in this population after accounting for several possible confounders. These data could serve as the basis for comparisons across hospitals and as a baseline for assessing changes in outcomes in the inpatient setting. Our findings suggest that improvements in the management of asthma exacerbations before hospitalization (e.g., at home, during transportation to the emergency department) will have the greatest benefit in further reducing the overall risk of death and in eliminating race disparities in asthma deaths.

Conflict of Interest Statement: V.K. does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript. G.B.D. does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript. C.S.R. served as a consultant for Merck (2002–2006) and Schering-Plough (2002–2006), participated as a member of the Mothers of Asthmatics/Atlanta Advisory Board in 2003, spoke at scientific meetings sponsored by Merck in 2004 and 2005, participated in an Advisory Meeting for Boehringer Ingelheim in 2005, participated and spoke at an educational meeting sponsored by Alcon in 2005, and served as a member of the Schering-Plough Respiratory Leadership Council in 2004 and 2005. A.B. does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript. B.M. does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript. N.H. does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript. J.A.K does not have a financial relationship with a commercial entity that has an interest in the subject of this manuscript.

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